DOCUMENT RESUME

ED 324 194 SE 051 464

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TITLE	Current Projects and Activities in K-12 Science Education Curriculum Development. ERIC/SMEAC Science Education Digest No. 3.
INSTITUTION	ERIC Clearinghouse for Science, Mathematics, and Environmental Education, Columbus, Ohio.
SPONS AGENCY	Office of Educational Research and Improvement (ED), Washington, DC.
REPORT NO	EDO-SE-90-27
PUB DATE	90
CONTRACT	RI88062006
NOTE	4p.
AVAILABLE FROM	ERIC/SMEAC, The Ohio State University, 1200 Chambers Road, Room 310, Columbus, OH 43212 ($1.00).
PUB TYPE	Information Analyses - ERIC Information Analysis Products (071)
EDRS PRICE	MF01/PC01 Plus Postage.
DESCRIPTORS	Academic Achievement; Curriculum Development; Educational Change; Educational Trends; *Elementary School Science; Elementary Secondary Education; Futures (of Society); Program Descriptions; Science and Society; Science Curriculum; *Science Education; *Secondary School Science; Technological Advancement
IDENTIFIERS	ERIC Digests

ABSTRACT

Advances in science and technology, information in philosophy and psychology, and changes in society have placed different demands on science education than was the case in the 1960's. Post-Sputnik era curricula in science were organized to reflect the structure of the discipline and were aimed primarily at encouraging students to pursue science or science-related careers. The curriculum projects currently underway in the 1990's focus more on science for all, with an emphasis on future citizens. This digest discusses large-scale, national projects designed to reform science education. Activities that focus on teaching science to elementary and middle school students are emphasized. A list of 12 references is provided. (CW)

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CURRENT PROJECTS AND ACTIVITIES IN K-12 SCIENCE EDUCATION CURRICULUM DEVELOPMENT

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U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

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ERIC/SMEAC Science Education Digest, No. 3, 1990.

SE051464

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ERIC/SMEAC Science Education Digest EDO-SE-90-27 No. 3, 1990

CURRENT PROJECTS AND ACTIVITIES IN K-12 SCIENCE EDUCATION CURRICULUM DEVELOPMENT

How do the reforms of the 90s differ from those of the post-Sputnik era?

To quote an active science curriculum developer, ". . . the 1990s are not the 1960s" (Bybee, 1990:92). Advances in science and technology, information in philosophy and psychology, and changes in society have placed different demands on science education. According to Bybee, these demands are such that they cannot be met through revision of the 1960s curriculum or current textbook programs - major reform is needed.

An increased understanding of how students learn is reflected in materials and instructional approaches that reflect the idea that learners build or construct their own knowledge based on their observations and experiences. If learners' self-constructed knowledge differs from the concepts presented in formal science instruction, curriculum materials and instructional approaches must be used that bring about conceptual change. Learners must be involved in experiences that challenge their current conceptions. Then they must be provided with more experiences and given time to reconstruct more adequate explanations or new concepts. Finally, learners must be given the opportunity to apply the new concepts and evaluate their adequacy. Because more time is required to learn concepts, fewer concepts can be taught during the school year

Post-Sputnik curricula in science were organized to reflect the structure of the discipline and were aimed primarily at encouraging students to pursue science or science-related careers. The curriculum projects currently underway appear to focus more on science for all, with their emphasis on future citizens.

As in the 1960s, the National Science Foundation is involved in supporting science curriculum development. The seven projects currently being developed at the elementary and middle school levels all involve triads of scientists and science educators, schools, and publishers. The science curriculum improvement projects of the 60s had supplementary materials in the form of lab blocks, films and filmstrips, and other media. Those of the 90s reflect advances in technology and involve interactive videodiscs, computers, and national computer networks, among other, more usual materials and equipment.

What are some large-scale projects?

Project 2061, *Science for All Americans*, is a project directed by F. James Rutherford for the American Association of the Advancement of Science (AAAS). Its central goal is that of developing answers for questions related to scientific literacy: (1) what is the substance of scientific literacy? (2) who should be expected to acquire the requisite knowledge and skills? (3) how can scientific literacy be achieved nationwide?

Six basic dimensions of scientific literacy were identified by the 2061 council: 1) being familiar with the natural world and recognizing both its diversity and its unity; (2) understanding key concepts and principles of science; (3) being aware of some of the important ways in which science, mathematics, and technology depend upon one another; (4) knowing that science, mathematics,and technology are human enterprises and knowing what that implies about their strengths and limitations; (5) having a capacity for scientific ways of thinking; (6) using scientific knowledge and ways of thinking for individual and social purposes (*Science for All Americans*, Summary, 1989:4).

Five criteria govern the choice of science content used to help achieve the goal of scientific literacy: (1) utility- in terms of long-term employment, in making personal decisions; (2) social responsibility - as an aid in making intelligent decisions on social and political matters involving science and technology; (3) intrinsic value of knowledge - information so important or so pervasive in our culture that a general education would not be complete without it; (4) philosophical value - aids a person's ability to ponder enduring questions of human meaning; and (5) childhood enrichment - will it enhance childhood rather than just possibly being useful in later life (*Science for All Americans*, 1989:21).

Phase II, involving the development of several alternative curriculum models, is currently underway in different locations. ERIC readers interested in specific sites and activities should contact AAAS, 1333 H Street, NW, Washington, DC 20005.

Also underway is a science reform effort originating with the Executive Director of the National Science Teachers Association, Bill Aldridge. Known as the NSTA Project on Scope, Sequence, and Coordination of Secondary School Science, this project is similar to 2061 in that its intent is to make science accessible to all students. Aldridge contends that American science education could be greatly improved if the sequence of offering separate courses, a different science each year, were abandoned in favor of spreading these subjects over the four (or six years) of a student's secondary education, with content from each of the sciences being taught each year in some appropriate fashion for the student's level of cognitive development.

There are two essential features of the model Aldridge proposes: (1) spaced learning, with science taught over several years; and (2) progression from the descriptive to the abstract in terms of concepts. Although Aldridge believes in separate science disciplines, this model could integrate (rather than coordinate) the sciences (*NSTA Reports!*, 1989).

However the science curriculum is organized, students in grade 7 and 8 should have an instructional approach that is descriptive and that involves experiences with phenomena in a hands-on setting. In grades 9 and 10, the approach shifts to empirical and becomes semiquantitative. In grades 11 and 12, science instruction can emphasize the theoretical and abstract aspects.

Project 2061 and the NSTA Scope, Sequence, and Coordination Project have focused primarily on secondary school science. Some school systems are already

modifying their science curriculum to more closely follow the guidelines established by Project 2061. This modified curriculum may be presented to students using the scope and sequence model proposed by NSTA.

What are the activities that focus on teaching science to elementary and middle school students?

As mentioned earlier, these curriculum projects involve scientists and science educators, schools, and publishers. Some materials are ready for trial and formative evaluation, others are still in production. These projects share some characteristics in that the curriculum materials are designed to help children develop an understanding of key concepts, hands-on activities are emphasized along with the development of problem-solving skills, science concepts are related to social and environmental concerns, and science is integrated with the rest of the elementary curriculum - especially writing, mathematics, and reading.

Several of the elementary school science projects make use of media. *Super Science*, funded by NSF and Scholastic, Inc. consists of two classroom magazines: one for grades 1-3 (red edition) and the other for grades 4-6 (blue edition). These magazines are accompanied by computer disk resources containing activities that blend science with math, reading, and social studies. Activities stress process skills and the teacher guide contains suggestions for extending the science concepts into other subjects.

The National Geographic Society's (NGS) Kids Network curriculum and software have been produced in collaboration with Technical Education Research Centers, Inc. (TERC) of Cambridge, MA, through funding from NSF and NGS as well as support from Apple Computers, Inc. The NGS Kids Network gives fourth, fifth and sixth grade students the opportunity to collect and analyze data and to share their findings through the extensive use of telecommunications. Kids Network units may be used to enrich existing courses or as a complete course. The units are blends of classroom activities, network exchanges, and software tools.

Addison-Wesley Publishers, along with NSF, is involved in the Life Lab Science Program. "The Growing Classroom" is a garden-based program for children in grades 2-6. It combines elementary school science and nutrition education, using hands-on activities that enable students to investigate in a cooperative learning setting.

"Insights" is an elementary school science curriculum targeted specifically to urban systems challenged by large numbers of low-income, minority, and special needs children. In such systems, science education has traditionally been a low priority. This is a collaborative effort of NSF, the Education Development Center in Newton, MA, and Wings for Learning, a Sunburst Company. The developers have made an effort to balance life, physical and earth sciences in choosing themes, topics, and natural phenomena to be investigated. Where appropriate, the experiences are tied to an urban setting. Designed for grades K-6, the curriculum will consist of modules organized around five themes: systems, change, structure and function, diversity, and cause and effect.

The Full Option Science System (FOSS) is the product of the Lawrence Hall of Science, NSF, and Encyclopedia Britanica Educational Corporation. This program is for students in grades 3-6. Like the other projects, FOSS is a hands-on laboratory science program. It will consist of 16 self-contained modules. Four modules, two at each grade-level grouping, will be focused on one of four themes: scientific reasoning, physical science, earth science, and life science. This program can be used to enrich a science program or serve as the program. FOSS is multisensory in design so that disabled students can experience science in mainstreamed settings.

The Houston Museum of Natural Science in cooperation with NSF and Silver, Burdett and Ginn is working on *The Science Connection* for grades 1-6. This project is designed to supplement existing basal science texts with materials to enhance science content and to improve students' abilities to think critically. *Science Adventure Storybooks* introduce science concepts within the context of everyday student experiences through high-interest adventures. *Extending Science, Interdisciplinary Activity Books* provide projects in language arts, fine arts, mathematics, and social studies that have science themes and apply science content. *The* "Science Mini-Museum Construction Kits" feature unique and interesting manipulatives.

The Biological Science Curriculum Study (BSCS), working with NSF and Kendall/Hunt Publishing Company, has developed *Science for Life and Living: Integrating Science, Technology and Health*. Designed to include a full year of instruction at each grade level, K-6, the program has three unifying themes: science as a way of knowing, technology as a way of doing, and health as a way of behaving. Reading, writing and mathematics are emphasized throughout the program where appropriate. The instructional model for this program is an adaptation of the learning cycle and is based on a constructivist view of learning (Bybee, 1990).

Florida State University, NSF, and Houghton Mifflin are working on the Interactive Media Science project, to be commercially marketed as Science Quest. This project, designed for students in grades six through nine, will have nine interactive video discs. Three discs each will be focused on topics in life science, earth/space, and physical science.

The fundamental assumption of Science Quest is that science should be multidisciplinary and should serve a general education function for all students. Activities are designed and structured to promote problem solving, decision making, and critical thinking skills. The program is intended to complement and support an existing middle school science curriculum (Dawson, 1990).

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This digest was funded by the Office of Educational Research and Improvement, U.S. Department of Education under contract no. RI-88062006. Opinions expressed in this digest do not necessarily reflect the positions or policies of OERI or the Department of Education.